

Transmeta's Second Generation Efficeon Microprocessor and Technology Roadmap

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Transmeta Corporation

October 2004
Fall Processor Forum

Agenda

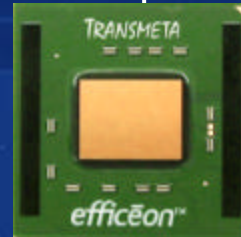
- Efficeon Processor Architecture
- Efficeon Generation 1 Implementation
- Efficeon Generation 2 Implementation
- Technology Roadmap

Transmeta Technology

Efficeon is the sum of

x86 Code Morphing Software

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Code Morphing Software

- ◆ Provides Compatibility
- ◆ Translates the 1's and 0's of x86 instructions to equivalent 1's and 0's for a simple VLIW processor
- ◆ Learns and improves with time

VLIW Hardware

- ◆ Very Long Instruction Word processor
- ◆ Simple and fast
- ◆ Fewer transistors

Low
Power

x86 PC
Compatibility

High
Performance

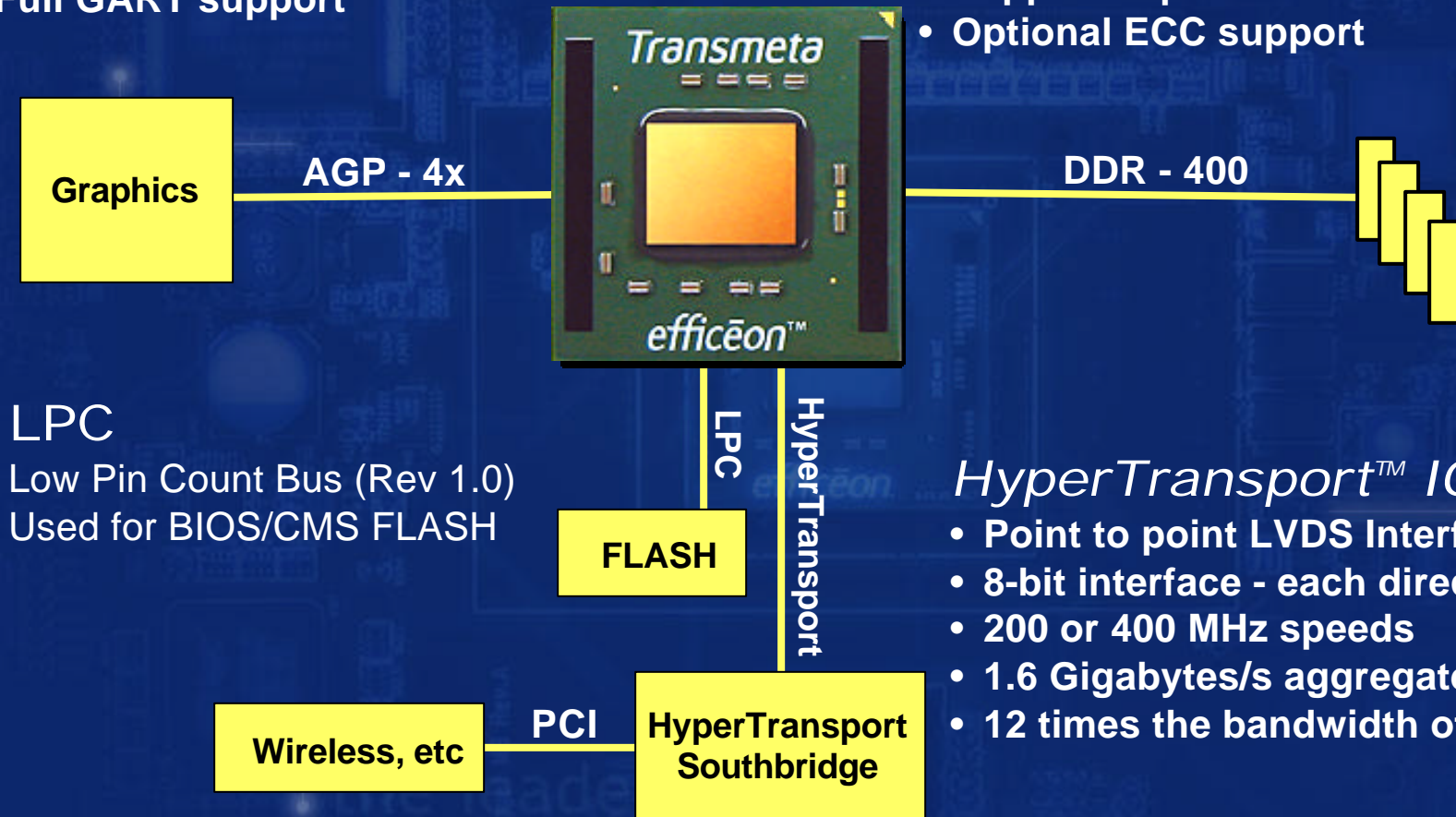
Efficeon Interfaces

AGP- 4X Graphics

- Supports 1X, 2X or 4X speeds
- AGP 2.0 compliant
- Full GART support

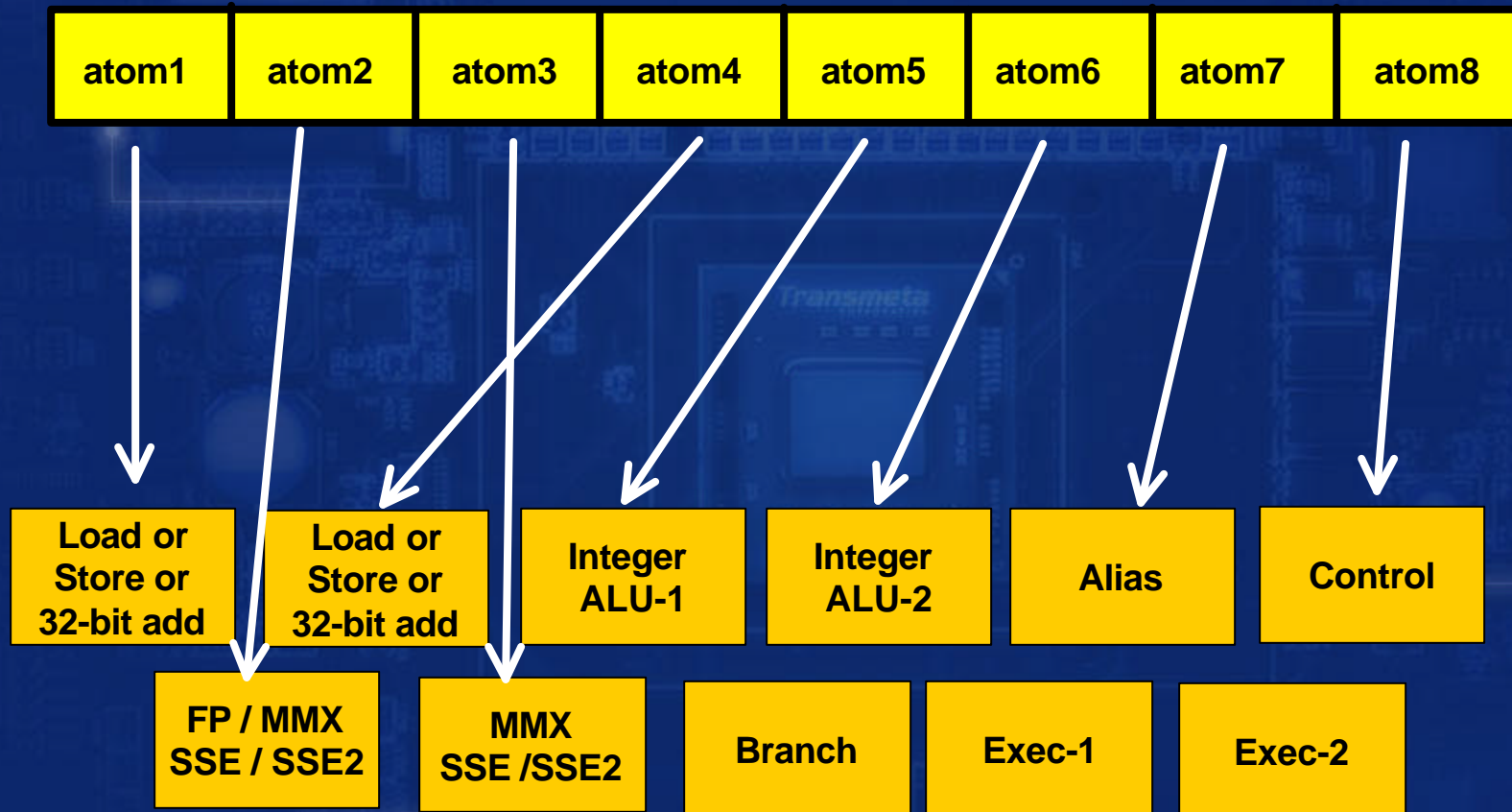
DDR-400 Memory

- High performance 64-bit DDR
- Up to 200MHz/400 Megaxfers/sec
- Supports up to 4GB of memory
- Optional ECC support



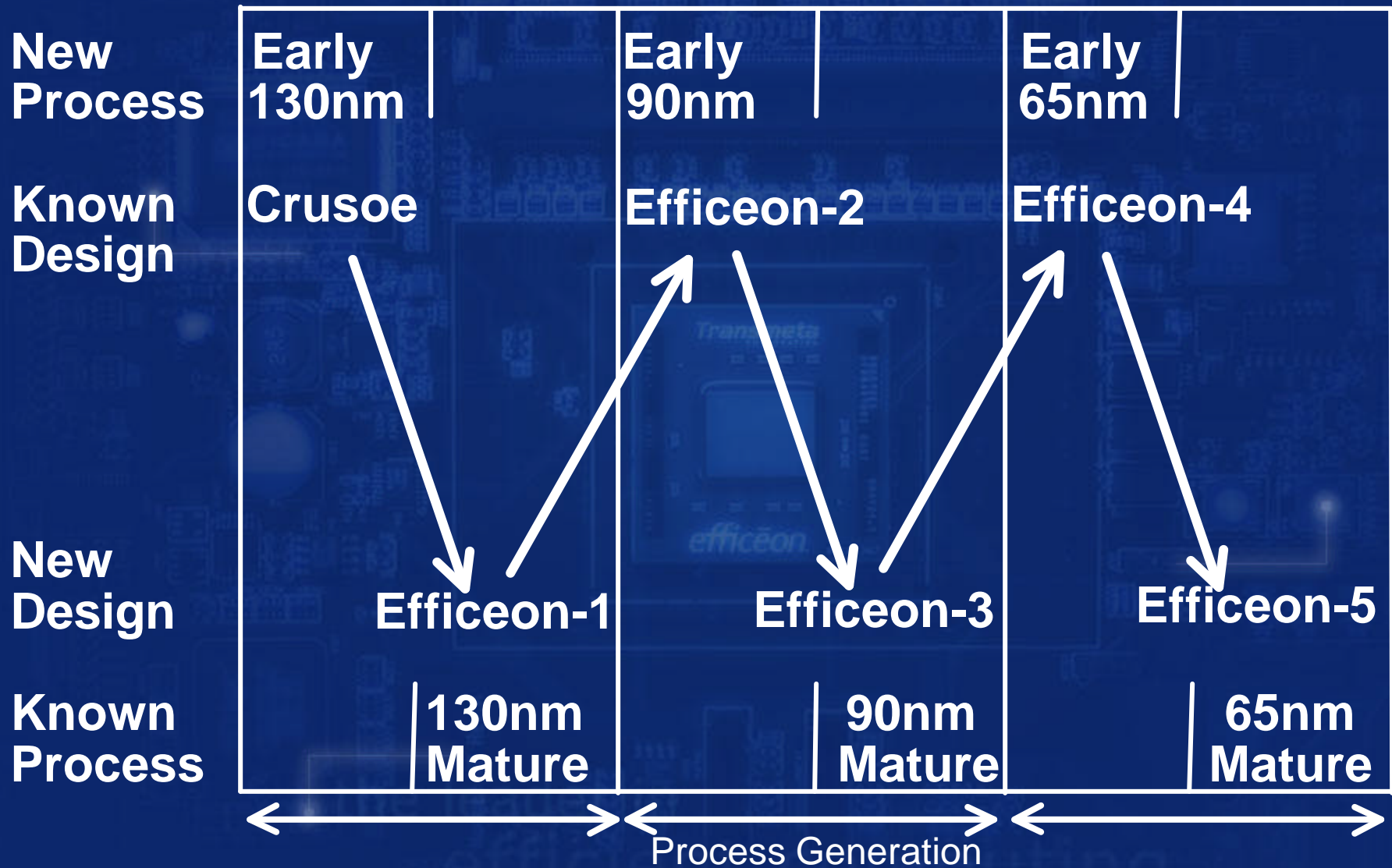
High Instruction Level Parallelism

Each clock, Efficeon can issue from one to eight 32-bit instruction “atoms”...



... to any of the above eleven logical execution units.

Transmeta Development Strategy





Efficeon Generation 1

Efficeon Roadmap

TDP= Maximum Thermal Power



Efficeon Generation-1

TSMC 130 nm

TM8600 Standard Package

TM8620 Small Package

1 GHz

7 Watt TDP

Q4 2003

2004

2005

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First Efficeon Notebook: Jan 04



Sharp Actius MM20

2 pounds (990 grams)

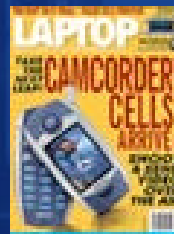
1.0 GHz Efficeon Processor

0.62 inches at thinnest point

NEASIA Powered by
Nikkei Electronics Asia
Online

February 16, 2004:

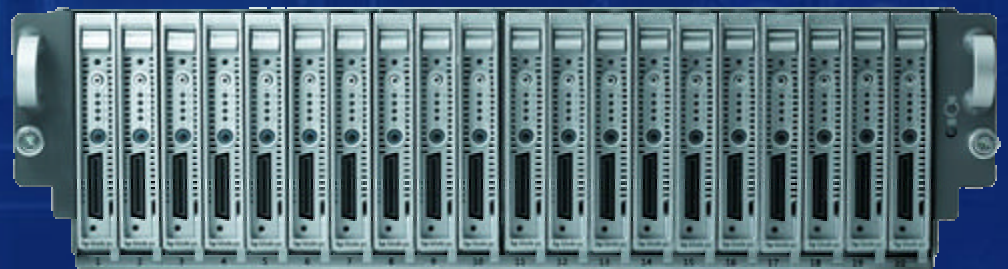
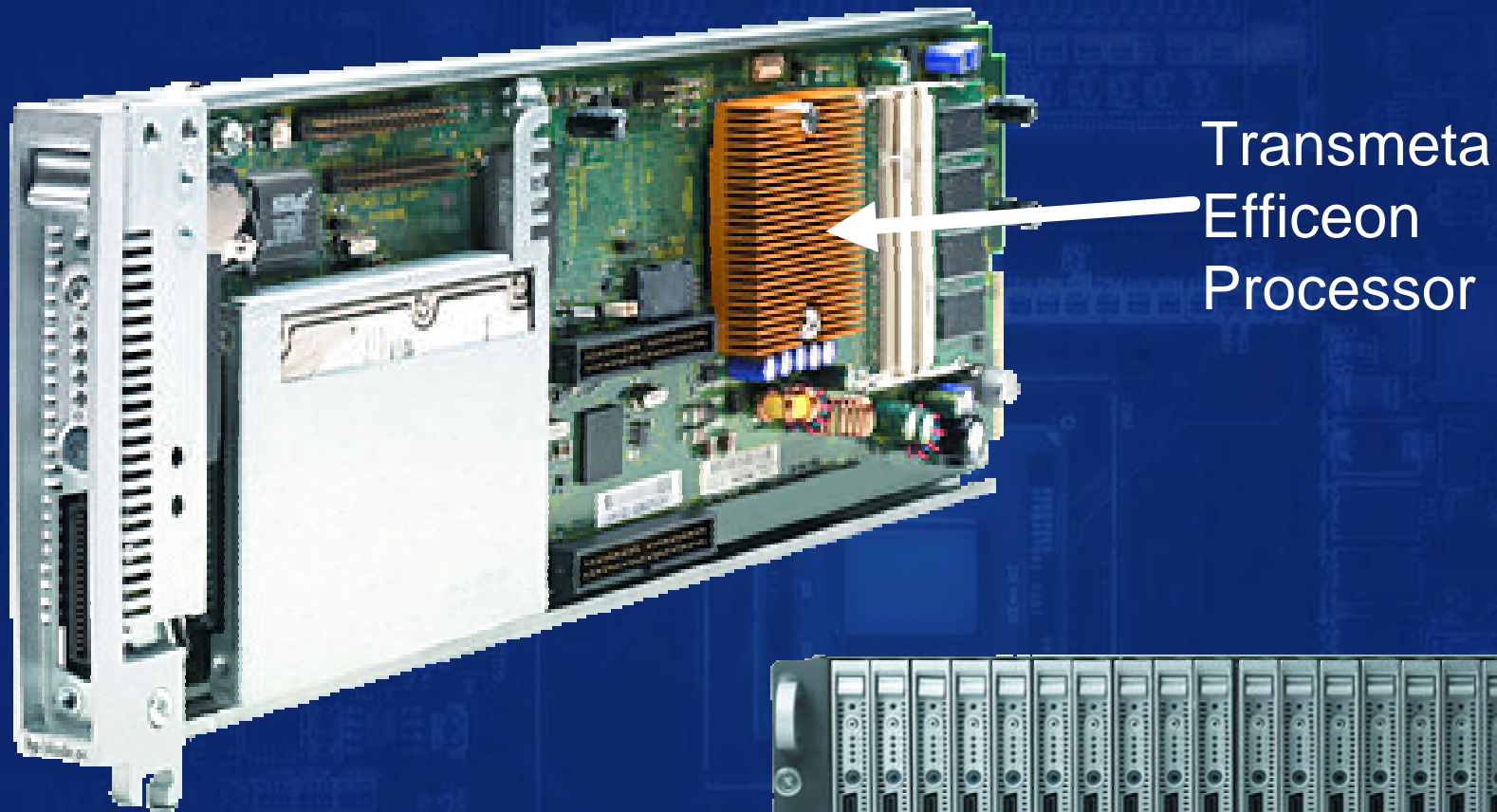
“Efficeon is as well armed as the Pentium M with strong performance and cost efficiency, and has the potential to become part of the mainstream in the mobile notebook computer market.”



April 2004:

“The MM20 has got the chops to go up against any Centrino machine running the low-voltage version of that processor.”

Efficeon in HP Blade PC: April 04



280 Efficeon Blades per 42U rack
20 Blades per 3U modular enclosure

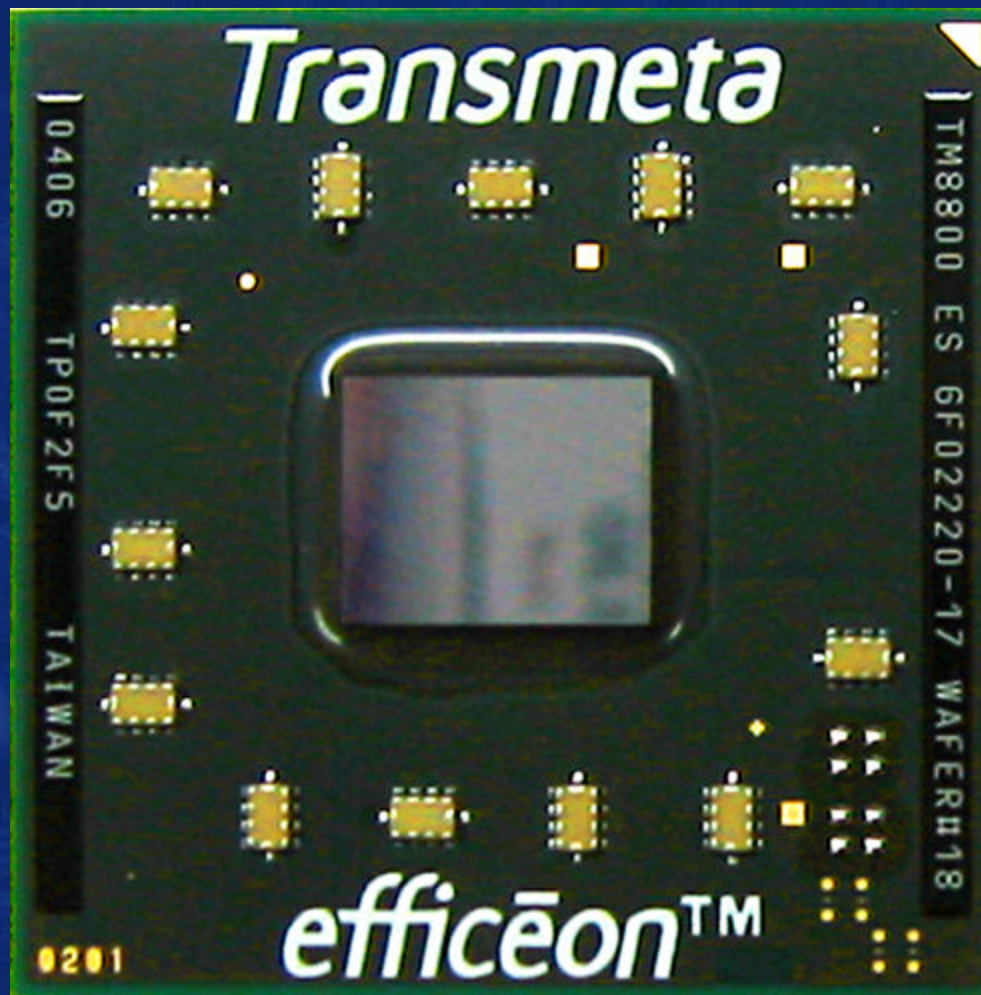


Efficeon Generation 2

Generation 2 Goals

In less than 1 year:

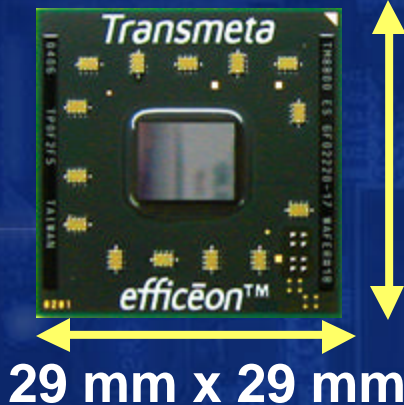
- Double performance from 1 GHz to ~2 GHz
- Move into higher volume 12-25 Watt segment
- Cut power in half for 1 GHz operation
- Remain pin compatible with generation 1 parts
- Provide easily recognizable feature differentiation
 - Virus Protection
 - Advanced Video Processing



The new 90nm second generation Efficeon Processor from Transmeta

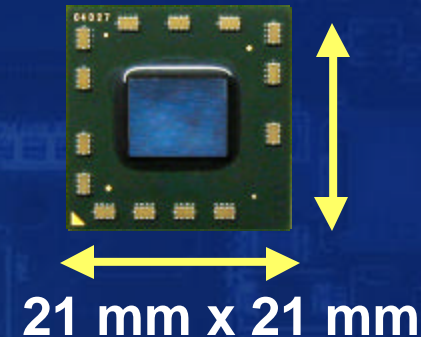
Second Generation Efficéon

TM8800



Same Die,
two different
packaging
options

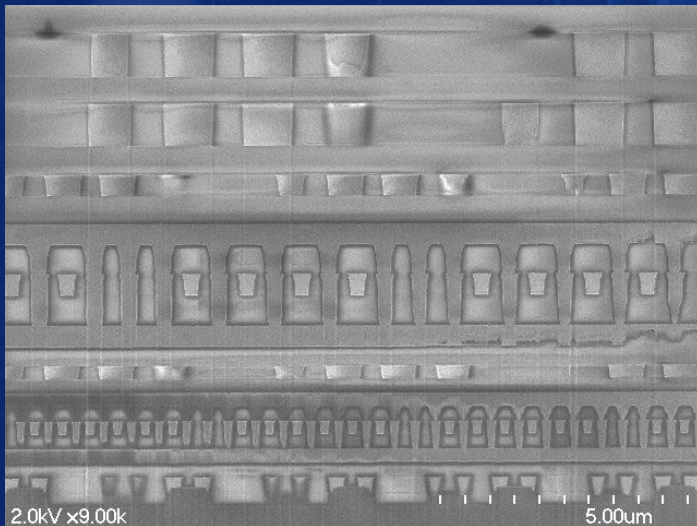
TM8820



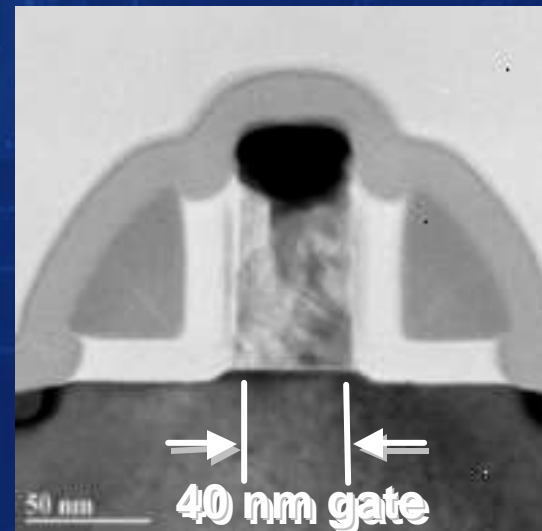
- 90 nm CMOS Technology
- Pin compatible with TM8600 and TM8620 130nm parts
- Product goals:
 - 1.0 – 1.1 GHz ~3 Watts max TDP
 - 1.4 – 1.6 GHz ~7 watts max TDP
 - 1.6 – 1.8 GHz ~12 watts max TDP
 - 1.8 – 2.0+ GHz < 25 watts max TDP

Technology Choice: Fujitsu 90nm

- Fujitsu provided the best 90nm technology choice for speed
- Up to 10 layers interconnect (8 used in Efficeon)
- Low-K dielectric
- Industry leading 40nm transistor gate length
- Small $\sim 1\mu^2$ SRAM cell



9Cu / 1Al Interconnect



Transistor Photo

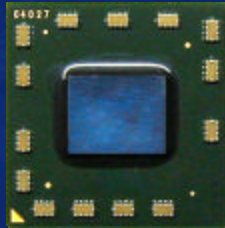
Anti-Virus Protection

- Efficeon 2 is the first low-power mobile processor to provide support for Antivirus protection
- New x86 memory management extension to protect against viruses exploiting buffer overflows – a common entry point for viruses and worms
- Allows Efficeon processor to mark memory locations as non-executable unless it explicitly contains executable code
- Works in conjunction with Microsoft's Data Execution Protection (DEP) feature in Windows XP Service Pack 2 (SP2)

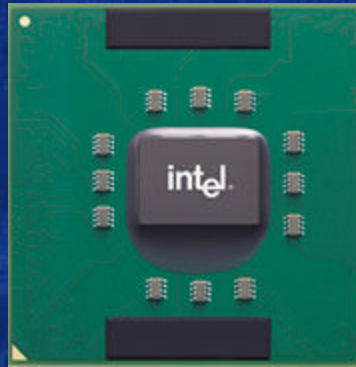
New Multimedia “SSE-3” Instructions

- **Graphics support:**
 - *haddpd, haddps, hsubpd, hsubps*: Horizontal add/subtract
- **Complex arithmetic support:**
 - *movddup, movshdup, movsldup*: loads and duplicates data
 - *addsubpd, addsubps*: adds and subtracts simultaneously
- **Video encoding support for MPEG-4**
 - *lddqu*: loads unaligned 128-bit data
- **General**
 - *fisttp*: x87 floating point to integer conversion

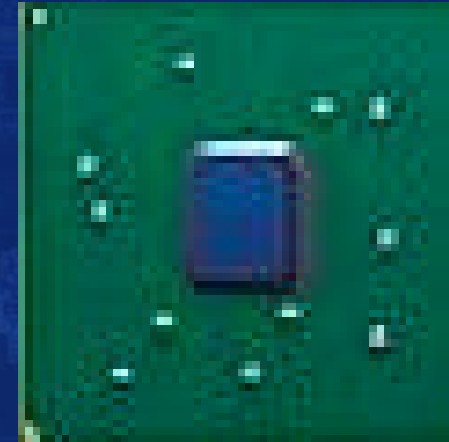
Space Efficiency Comparison



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Transmeta TM8820
CPU + Northbridge
21mm x 21mm

Intel Pentium-M
CPU
35mm x 35mm

Intel 855PM MCH
Northbridge
37.5mm x 37.5mm

TM8820 is 36% the size of Pentium-M alone

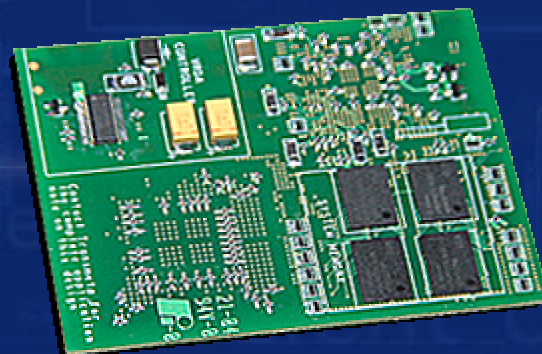
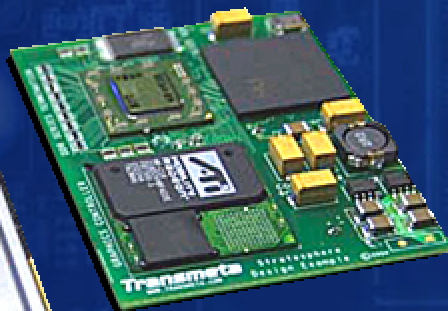
TM8820 is 17% the size of Pentium M + Northbridge

Small Form Factor Design Example

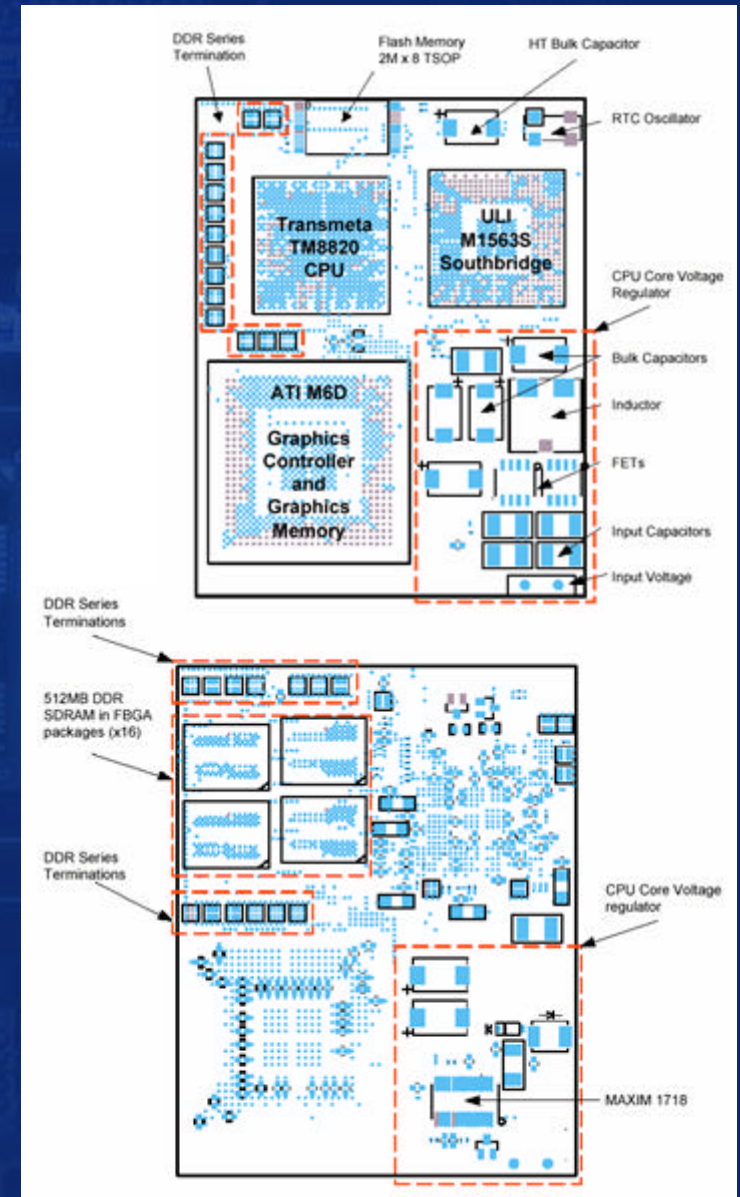
- Entire core PC logic on a tiny board
 - TM8620 CPU/NB(21mm x 21mm) and
 - ULI1563S Southbridge (23mm x 23mm)
- Enables compact form factors
- Total Board Size – 78mm x 62mm similar to PCMCIA card



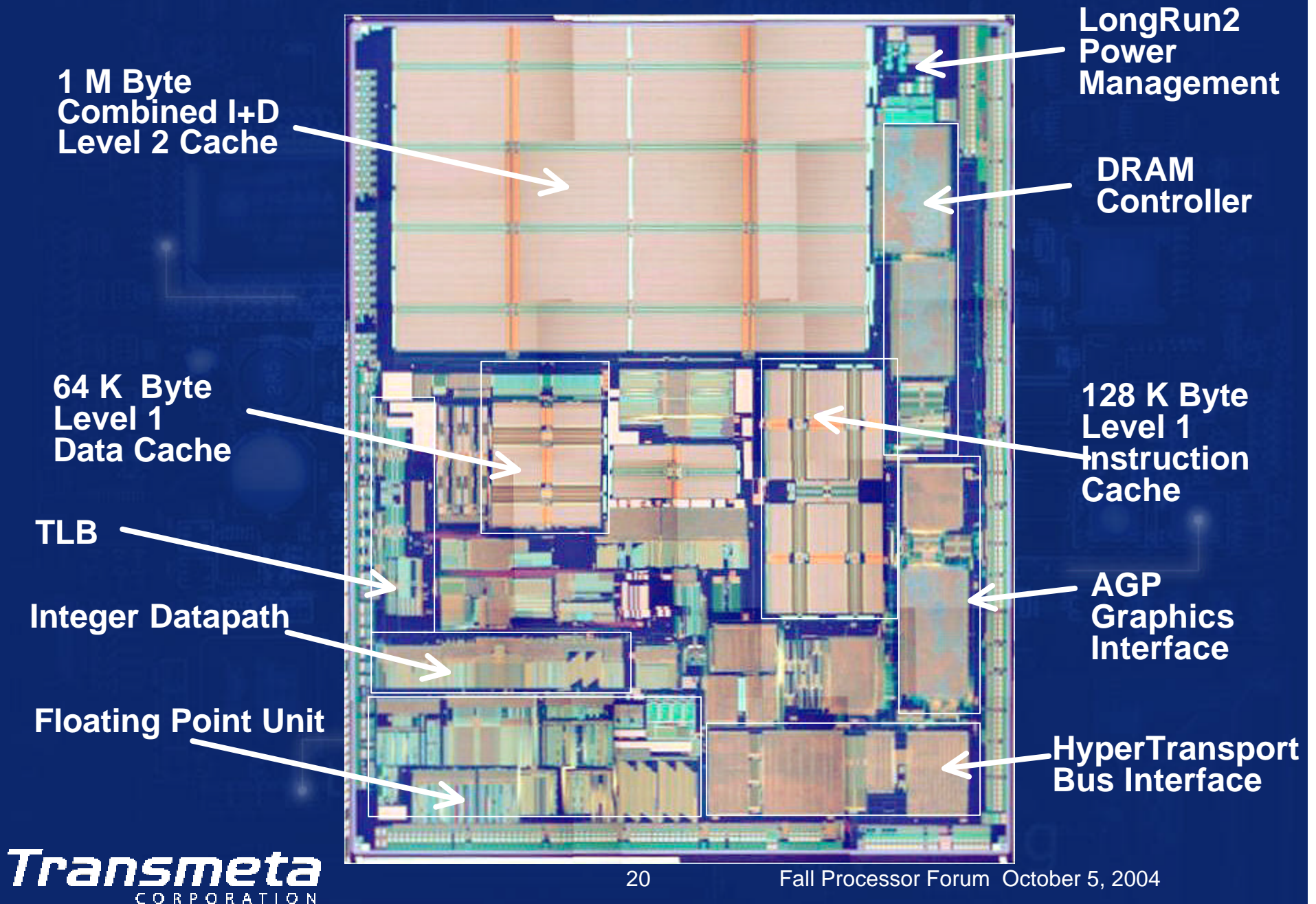
PCMCIA Card
(Size reference)



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Efficeon 2 Die Photo and Layout





First Efficeon-2 Notebook Sharp PC-MP70G

- Launched in Japan Sept 9th, 2004
- Uses 1.6 GHz Efficeon TM8800 Processor
- 2.8 pounds (1.26 kg)
- 10.4 inch LCD screen
- 2 spindle (Hard Disk and DVD)

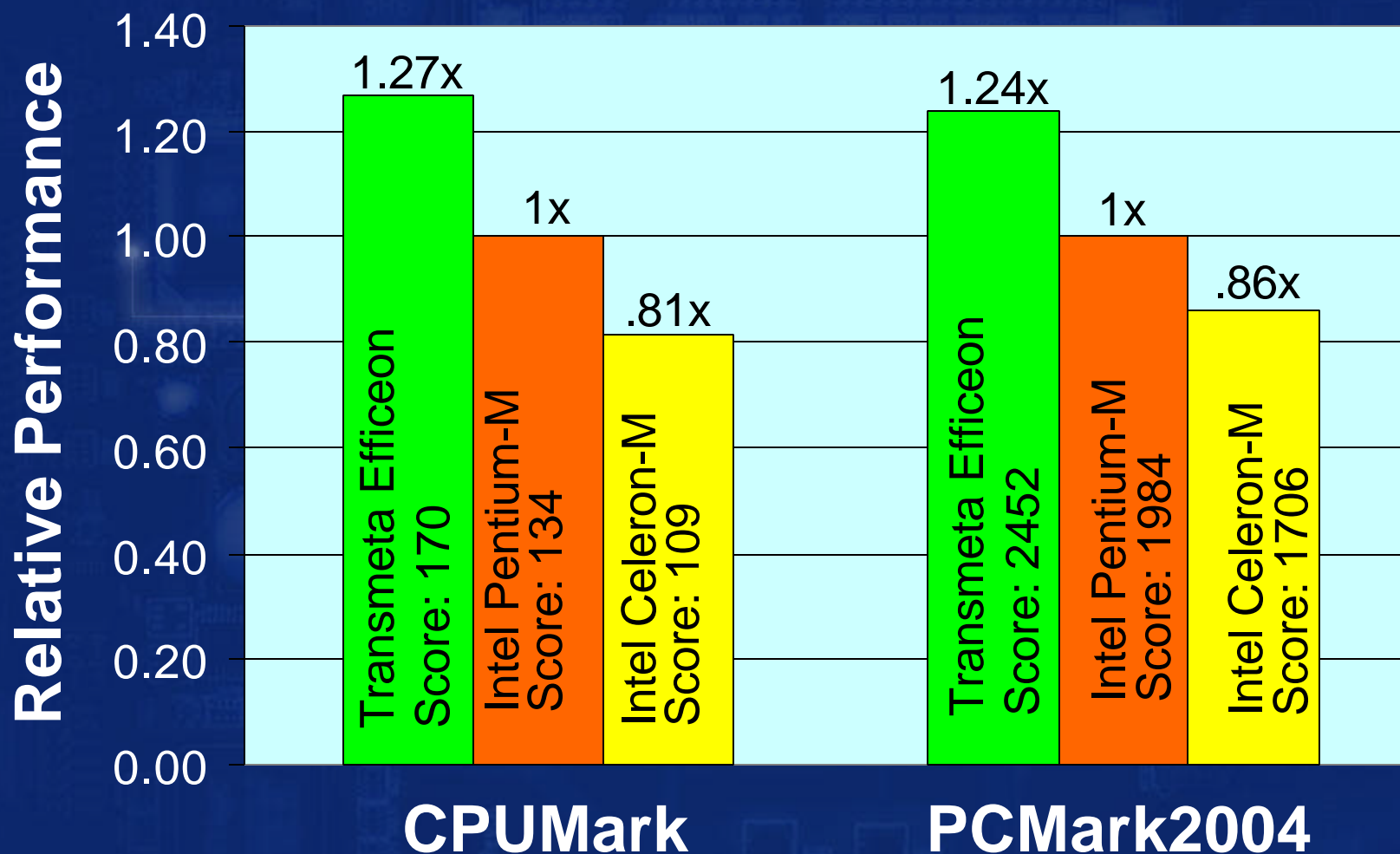
Nearest competitive systems are new SONY T-Series
3 pounds, 10.6" LCD, 2 spindle

CPU: 1.1 GHz Pentium-M model 733 and
933 MHz Celeron-M model 353



Performance Comparison

using best MHz of recent < 3 lb 10.6" notebooks



Benchmarks run at Transmeta on systems as similarly configured as possible

Efficeon-2 data measured at 1.6 GHz with 512MB DDR333, 5400rpm 2.5" HDD, NV17 graphics

Intel Pentium-M data measured at 1.1 GHz with 512MB DDR333, 5400rpm 2.5" HDD, i855GMCH

Intel Celeron-M data estimated by measuring Celeron-M at 800 MHz (scores: 97/1517) and estimating 933 MHz score

First Clustered Workstation with TM8800

Orion Multisystems DS-96

- Deskside Personal Supercomputer
- 96 Efficeon TM8800 Processors
- 300 GigaFlops on DP Linpack
- Standard electrical wall outlet



Efficeon excels at “Dense Computing”

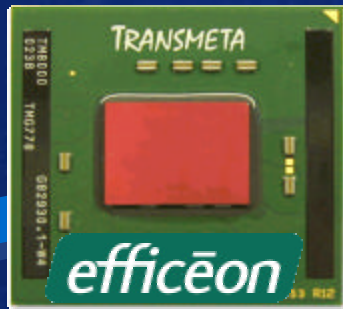
	Frequency	Power	~Performance	
			SpecInt/Watt	SpecFP/Watt
Efficeon	1.5 GHz	7 Watts	97.6	77.5
AMD Opteron 148	2.2 GHz	86 Watts	16.3	17.5
Intel Xeon	3.2 GHz	86 Watts	14.8	14.0
IBM Power4	1.7 GHz	100 Watts	10.8	16.0
Intel Itanium 2	1.5 GHz	130 Watts	10.2	16.3

source: Microprocessor Report December 2003 and Transmeta

Technology Roadmap

Efficeon Roadmap

Announced
October 2003



Efficeon Generation-1
TSMC 130 nm

1 GHz / 7 Watt

Announced
October 2004



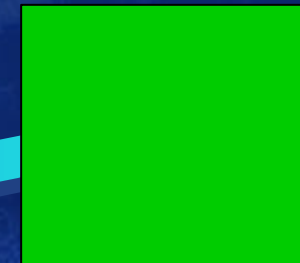
Efficeon Generation-2
Fujitsu 90 nm

Product Goals

1.8 - 2.0 GHz / < 25 Watt
1.6 - 1.8 GHz / 12 Watt
1.4 - 1.6 GHz / 7 Watt
1.0 - 1.1 GHz / 3 Watt

Improved Microarchitecture

Higher Work/Clock
Fewer Gates/Clock
2x More Cache
3x Faster DRAM bus
4x Faster HT bus



Efficeon Generation-3/4*
90 nm / 65 nm

2003

2004

2005

* = Current plans, subject to change

What's Next?

Here are a few things we're working on:

- More MHz moving up into mainstream notebooks
- Lower Power
- LongRun2 Power Management
- Virtualization
- Licensing of Transmeta Technology for SOC Cores
- 64-bit instruction extensions
- 65 nm CMOS Technology

Summary

- Second generation 90 nm Efficeon-2 is a major leap forward
- Able to ship first all layer silicon, using only metal and CMS changes
- Subsequent tapeouts will improve MHz and reduce power further
- Efficeon-2 leads in performance when low power is a constraint
- Efficeon-2 leads in compact space solutions
- Efficeon-2 opens the door to higher volume platforms
 - Mainstream notebooks
 - Media center PC, STB's and PVR's
 - Blade servers and Blade PC's
 - UPC handheld devices



Transmeta

C O R P O R A T I O N